

ALL PRIVATE INITIATIVE TO RETURN TO THE MOON

**ADVANTAGES,
OPPORTUNITIES, STRATEGY
AND POSSIBLE APPROACH**

ALL PRIVATE INITIATIVE ADVANTAGES

- **SAVES TAXPAYER RESOURCES**
- **HARNESSES MARKETPLACE
EFFICIENCIES**
 - **MODIVATIONAL AND FINANCIAL
INCENTIVES FOR SUCCESS**
 - **COMPETE FOR THE BEST MANAGERS
AND ENGINEERS**
 - **ENFORCED COST CONTROL**
- **GOVERNMENT NOT BOTH A
IMPLEMENTOR AND A REGULATOR**

ALL PRIVATE INITIATIVE DISADVANTAGES

- **POTENTIAL INTERNATIONAL OBJECTIONS**
- **NASA / DOE RESENTMENT**
- **REGULATORY HURDLES**
 - **LICENSES**
 - **FINANCIAL REPORTING**
- **FINANCING REQUIREMENTS TOUGH TO FILL**
- **LEGAL LIABILITIES**

MAJOR BUSINESS CONSIDERATIONS

- **BUSINESS STRATEGY**
- **ADDRESSABLE MARKET**
- **BARRIERS TO ENTRY**
- **COMPETITION**
- **DEVELOPMENT PLAN / MILESTONES**
- **ORGANIZATION**

BUSINESS STRATEGY

PRIMARY

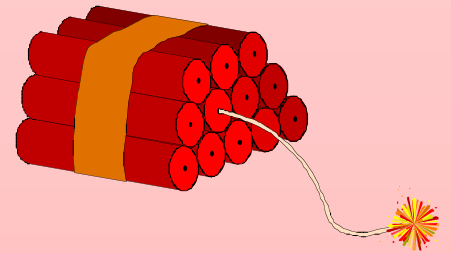
- **CREATE COMMERCIAL ENTERPRISES RELATED TO “RESOURCES FROM SPACE”**
 - **RESOURCES FOR USE ON EARTH** (ALL FOLLOWS FROM THIS)
 - HELIUM-3
 - **RESOURCES FOR USE IN EARTH ORBIT**
 - HYDROGEN, WATER, OXYGEN
 - FOOD, RADIATION SHIELDING
 - » SOLAR CELLS, POWER, METALS
 - **RESOURCES FOR USE IN SPACE TRANSPORTATION**
 - HYDROGEN, OXYGEN
 - FOOD, RADIATION SHIELDING
 - **RESOURCES FOR USE BY LUNAR AND MARTIAN SETTLERS**
 - HYDROGEN, WATER, OXYGEN
 - FOOD
 - **RESOURCES (TECHNOLOGY) FOR PROTECTION FROM ASTEROIDAL AND COMETARY COLLISIONS**
 - HEAVY LIFT LAUNCH CAPABILITY

BUSINESS STRATEGY

BASIS PREMISES

- **STRATEGY RESTS ON TWO BASIC PREMISES:**
 - **1. THE UNITED STATES AND THE WORLD WILL NEED AN ALTERNATIVE TO EXISTING SOURCES OF ELECTRICAL POWER EARLY IN THE 21ST CENTURY.**
 - **2. HELIUM-3 FUSION FUELED FROM THE MOON IS A FEASIBLE ALTERNATIVE**

THE PROBLEM



- **10 -12 BILLION EARTHLINGS BY 2050**
- **>X8 INCREASE IN ENERGY DEMAND**
 - **X2 TO STAY EVEN WITH 2000 DEMAND**
 - **X4 OR MORE TO MEET ASPIRATIONS AND TO SLOW POPULATION GROWTH**
 - **X? TO MITIGATE CLIMATE CHANGE**

LUNAR HELIUM-3 FUSION JUSTIFICATION AS A GLOBAL ENERGY ALTERNATIVE

- **NO RADIOACTIVE FUEL**
- **LITTLE OR NO RADIOACTIVE WASTE**
- **REDUCTION OF THE ENVIRONMENTAL IMPACT OF POWER GENERATION**
- **NO EXTERNAL EFFLUENTS**
- **CONVERSION EFFICIENCIES AT 60% OR MORE**
- **RELATIVELY LOW CAPITAL COSTS AND SIMPLICITY OF PLANT DESIGN**

- **“OH, BY THE WAYS”**
 - **POTENTIAL FOR A NEW DOMESTIC INDUSTRIAL AND EXPORT BASE**
 - **IMPORTANT SPIN-OFF TECHNOLOGIES**
 - **POTENTIAL FOR LESS EXPENSIVE ELECTRICAL POWER**
 - **CONCURRENT DEVELOPMENT OF OTHER SPACE RESOURCES**
 - **CONCURRENT DEVELOPMENT OF THE CAPABILITY TO DEFLECT EARTH-CROSSING ASTEROIDS**

BUSINESS STRATEGIES

ANCILLARY

- **PROVIDE A COMPETITIVE RETURN TO INVESTORS**
- **PROTECT THE EARTH'S ENVIRONMENT AND INCREASE THE WELL-BEING OF ITS INHABITANTS**
- **SUPPORT NEAR-EARTH, DEEP SPACE ACTIVITIES, AND HUMAN SETTLEMENT**
- **ESTABLISH THE HUMAN SPECIES IN DIVERSE, SELF-SUFFICIENT ENCLAVES**
- **DEVELOP RELIABLE AND ROBUST LUNAR LAUNCH CAPABILITIES AT <\$1000/KG**
- **ENDOW A WORLD-CLASS SPACE BIOMEDICAL SCIENCES INSTITUTE**
- **SUPPORT RESEARCH RELATED TO RESOURCES FROM SPACE**
- **DEVELOP THE TECHNICAL AND ORGANIZATIONAL CAPABILITY TO DEFLECT ASTEROIDS AND COMETS**
- **WORK TO GUARANTEE THAT BOTH THE SPACE TREATY ENVIRONMENT AND NATIONAL REGULATORY AND ECONOMIC STRUCTURES ENCOURAGE SPACE ENTERPRISE.**
- **ENDOW A "SOLAR SYSTEM FLEET ACADEMY"**
- **ENDOW AN INTERNATIONAL ENERGY AND ENVIRONMENT FOUNDATION**

HELIUM-3 FUSION

U.S.MARKET POTENTIAL

- ENERGY EQUIVALENT VALUE IS ABOUT **\$3 BILLION / TONNE** AT \$21 / BARREL FOR OIL,
- THE NO GROWTH ELECTRICAL POWER MARKET FOR THE U.S. ALONE IS ABOUT **\$120 BILLION / YEAR**.
 - EQUIVALENT TO ENERGY IN **~40 TONNES** OF HE-3
- FOR SOME PERSPECTIVE, THE APOLLO PROGRAM COST ABOUT **\$64 BILLION** IN TODAY'S DOLLARS.
- THE US GROWTH MARKET IN 2050, AND AFTER NEARLY TOTAL POWER INFRASTRUCTURE REPLACEMENT, WOULD BE ABOUT **\$200 BILLION /YEAR**.
- THESE MACRO-ECONOMIC FIGURES SUGGEST THAT A LUNAR MINING OPERATION MAY BE COMMERCIAL IF START-UP COSTS CAN BE FINANCED
 - THAT IS, FIND INVESTMENTS OF **AN AVERAGE OF ~1 BILLION DOLLARS / YEAR FOR ABOUT 15 YEARS WITH RETURNS ON INVESTMENT BEGINNING WITHIN THE FIRST 3-5 YEARS**.

ADDRESSABLE MARKETS

PRE-2018*

- **ISOTOPE PRODUCTION AT POINT-OF-USE**
 - ONE WATT OF FUSION POWER ($Q \ll 1$)
- **USE OF PROTONS AND NEUTRONS: WASTE TRANSMUTATION AND NEUTRON ACTIVATION ANALYSIS**
 - KILOWATTS OF FUSION POWER ($Q < 1$)
- **MODULAR POWER UNITS FOR MOBILE APPLICATIONS**
 - MEGAWATTS OF FUSION POWER ($Q > 1$)



INCREASED RATE AND AMOUNT OF FINANCING COULD
MAKE THIS DATE AS EARLY AS 2010 BUT NOT MUCH EARLIER.

ADDRESSABLE MARKET POST-2018

- **REPLACEMENT OF OLD ELECTRIC GENERATING PLANTS**
 - **HELIUM-3 FUSION POWER PLANTS**
- **NEW ELECTRICAL ENERGY DEMAND**
 - **HELIUM-3 FUSION POWER PLANTS**
- **LUNG IMAGING DEMAND**
 - **HELIUM-3**
- **SPACE STATION CONSUMABLES SUPPLY**
 - **WATER AND OXYGEN**
- **SPACE STATION RE-BOOST CONSUMABLES**
 - **HYDROGEN AND OXYGEN**
- **SPACE PAYLOAD DEMAND**
 - **LOW COST HEAVY LIFT LAUNCH CAPABILITY**

ADDRESSABLE MARKET POST-2023

- **SPACE TOURISM DEMAND**
 - **MAN-RATED, LOW COST HEAVY LIFT LAUNCH CAPABILITY**
 - **PRICED AT MARGINAL COST ON LUNAR BASE SUPPORT LAUNCHES**
- **LUNAR SCIENCE AND ASTRONOMY**
 - **SERVICES AT OPERATING LUNAR BASE**
- **MARS EXPLORATION CONSUMABLES**
 - **WATER, OXYGEN, FOOD, RADIATION SHIELDING, HELIUM-3 FUEL**

ADDRESSABLE MARKET POST-2028

- **SPACE STATION EXPANSION /
REPLICATION**
 - **CONSTRUCTION METALS (TI, AL), SOLAR
CELLS**
- **MARS BASE CONSUMABLES**
 - **WATER, OXYGEN, FOOD, HYDROGEN?**
- **LUNAR SETTLEMENT**
 - **EVERYTHING THAT WOULD BE NEEDED?**

ADDRESSABLE MARKET POST-2033

- **INITIAL MARS SETTLEMENT
CONSUMABLES**
 - **WATER, OXYGEN, FOOD, HYDROGEN?**
- **SOLAR SYSTEM EXPLORATION**
 - **ALL CONSUMABLES**
 - **PROPULSION AND POWER FUELS**
 - **CREWS**

BARRIERS TO ENTRY

- **FINANCING**
 - **BRIDGING BUSINESS OPPORTUNITIES**
 - **GOVERNMENT SUPPORT OF R&D**
- **INTERNATIONAL OBJECTIONS**
 - **GOVERNMENT SUPPORT OF PRIVATE SPACE ACTIVITIES**
- **FUSION TECHNOLOGY LIMITATIONS**
 - **AGGRESSIVE RESEARCH**
- **LOW COST TERRESTRIAL POWER ALTERNATIVES**
 - **COMPETITIVE PRICING**
 - **POLITICAL ARGUMENTS FOR TRUE VALUE PRICING**
 - **FUTURE UNMET DEMAND TOO GREAT**

COMPETITION

- **PETROLEUM**
 - **PRICE INSTABILITY, POLITICAL THREATS, CHEMICAL REQUIREMENTS, CLIMATE UNCERTAINTY, HYDROGEN AS PORTABLE FUEL**
- **COAL**
 - **CLIMATE UNCERTAINTY, CHEMICAL REQUIREMENTS**
- **NEXT GENERATION FISSION POWER**
 - **PUBLIC PERCEPTIONS, WASTE DISPOSAL, INEFFICIENCY OF CONVERSION**
- **D-T FUSION**
 - **TECHNICAL HURDLES, COMMERCIALIZATION BARRIERS, WASTE DISPOSAL**
- **RENEWABLES**
 - **NO GLOBAL CAPABILITY, INDIRECT ENVIRONMENTAL IMPACT, ENERGY STORAGE ISSUES**
- **SPACE SOLAR POWER**
 - **COST?, INDIRECT ENVIRONMENTAL IMPACT**

COMPETITION GOVERNMENT

- **GOVERNMENT FUNDED SPACE ENERGY INITIATIVE**
 - **HELIUM-3**
 - **LUNAR OR SPACE-BASED SOLAR POWER**
 - **FUNDING PROBABLY NOT POSSIBLE DUE TO ENTITLEMENT DEMANDS AND OTHER BUDGETARY CONSIDERATIONS**
 - **CRISIS CATALYST A LA APOLLO?**
- **INTERNATIONAL GOVERNMENTAL COOPERATION**
 - **PROHIBITIVELY COMPLEX UNDER EXPECTED MECHANISMS**
 - **HISTORY SHOWS THAT COSTS WILL INCREASE AND MANAGEMENT EFFICIENCY WILL DECREASE**
 - **INTELSAT MODEL IS THE PARTIAL EXCEPTION**
- **EITHER WOULD MAKE PRIVATE INITIATIVE VERY DIFFICULT OR IMPOSSIBLE**

ROLES FOR GOVERNMENT

- **MAINTAIN A FAVORABLE TREATY, REGULATORY, AND TAX ENVIRONMENT**
- **DEFEND LEGAL ACTIVITIES IN SPACE BY U.S. ENTITIES FROM ILLEGAL THREATS**
- **SET AND ENFORCE SAFETY, HEALTH AND ENVIRONMENTAL STANDARDS THROUGH LICENSING AUTHORITY**
- **BE A CUSTOMER FOR RESOURCES AND SERVICES THAT FILL LEGITIMATE PUBLIC NEEDS**
- **PROTECT NATIONAL INTERESTS AS REQUIRED**

COMPETITION

NUCLEAR FISSION PLANTS

- **MOST SERIOUS POTENTIAL COMPETITIVE THREAT TO HELIUM-3 FUSION**
 - **MITIGATED BY POLITICAL ENVIRONMENT IN U.S.**
 - **POLICIES LIMITING DEVELOPMENT OF BREEDER REACTORS AND/OR REPROCESSING OF SPENT FUEL**
 - **UNCERTAINTIES RELATED TO WASTE DISPOSAL AND DECOMMISSIONING WILL ADD FURTHER UNCERTAINTY**
 - **POLITICAL VIABILITY REMAINS UNCERTAIN DUE TO PERCEIVED LEVELS OF RISK**
 - **BROWN'S FERRY, THREE MILE ISLAND, CHERNOBYL, JAPAN AND OTHERS**
 - **MISHAPS ANYWHERE DON'T HELP FISSION.**
- **HOWEVER,**
 - **MUCH OF THE REST OF THE DEVELOPED WORLD IS HEADED IN TOWARD RELIANCE ON FISSION**

HELIUM-3 FUSION ADVANTAGES OVER FISSION

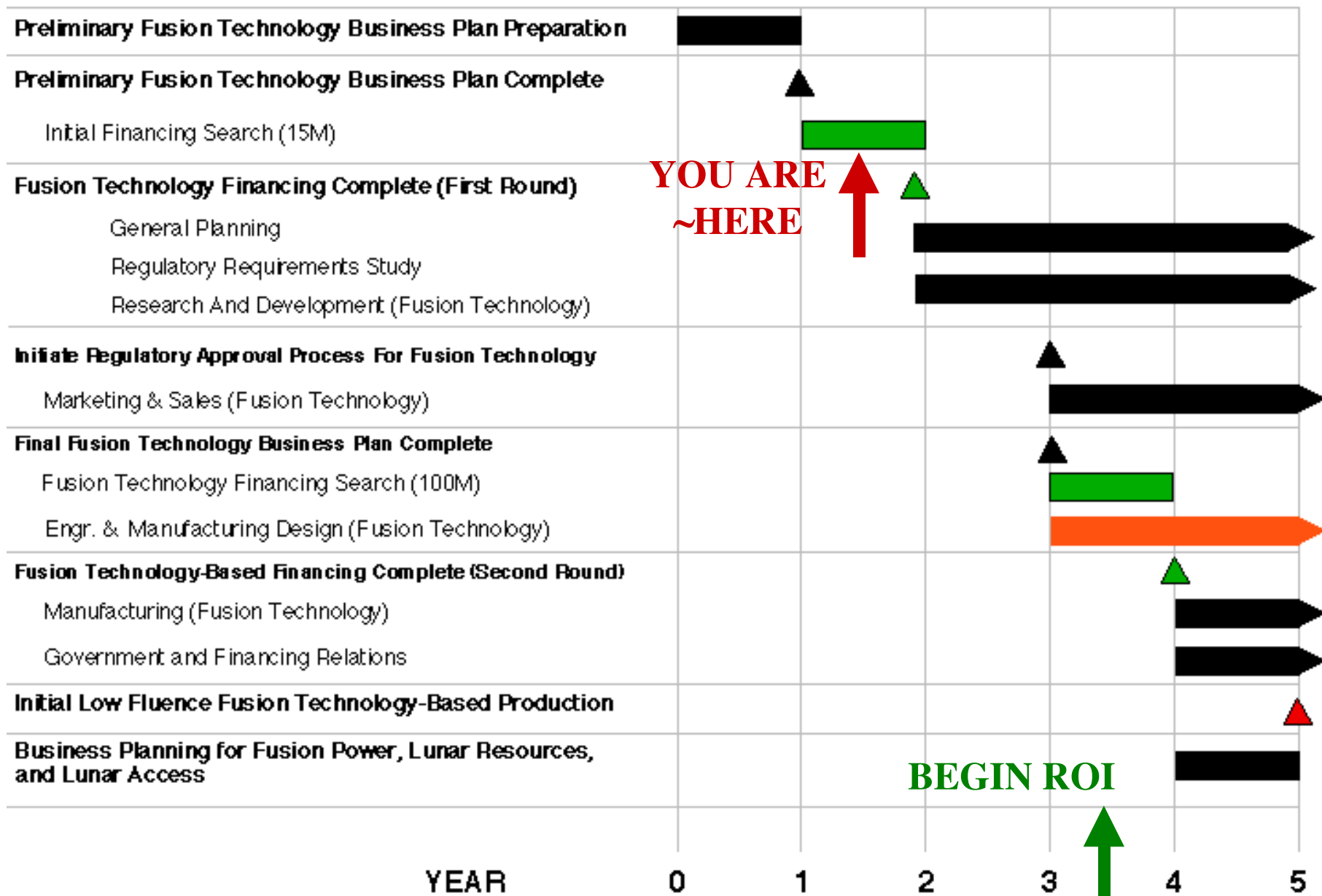
- **RELATIVELY SIMPLE PLANT DESIGNS**
- **PROTONS AND ALPHAS ARE THE PRIMARY REACTION PRODUCTS**
- **ELECTRICITY CAN BE PRODUCED BY DIRECT CONVERSION AT EFFICIENCIES >60%**
- **LITTLE OR NO RADIOACTIVE WASTE IS PRODUCED**
- **NO LOSS OF COOLING PROBLEMS EXIST**
- **PLANT DECOMMISSIONING WILL BE ROUTINE**

DEVELOPMENT PLAN AND MILESTONES

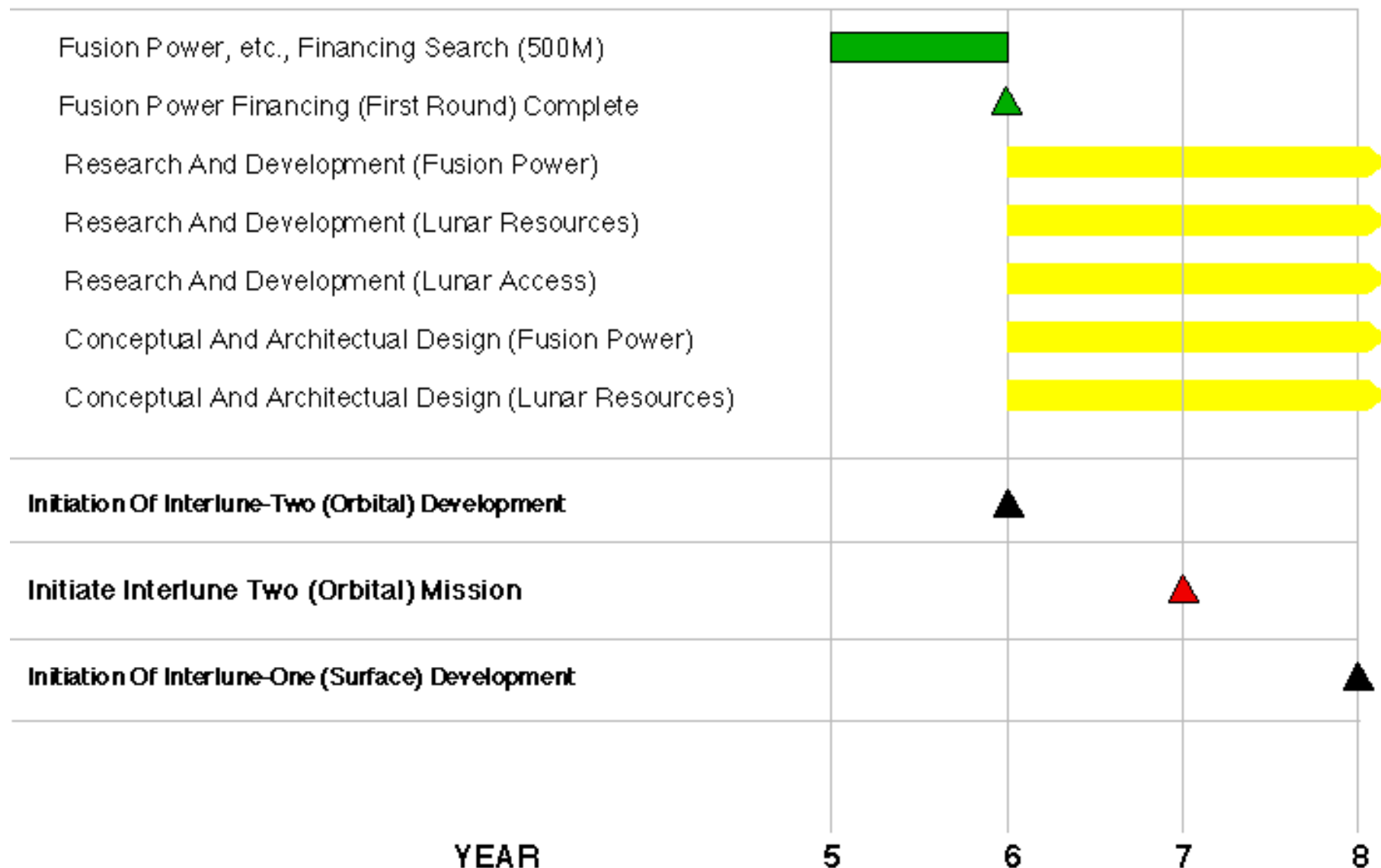
**BASED ON ~18* YEARS FROM
INITIAL FINANCING TO
DELIVERY OF FIRST 100KG HE-3
TO FIRST OPERATING
1000 MEGAWATT FUSION PLANT**

* INCREASED RATE AND AMOUNT OF FINANCING COULD
MAKE THIS DATE AS EARLY AS 2010 BUT NOT MUCH EARLIER.

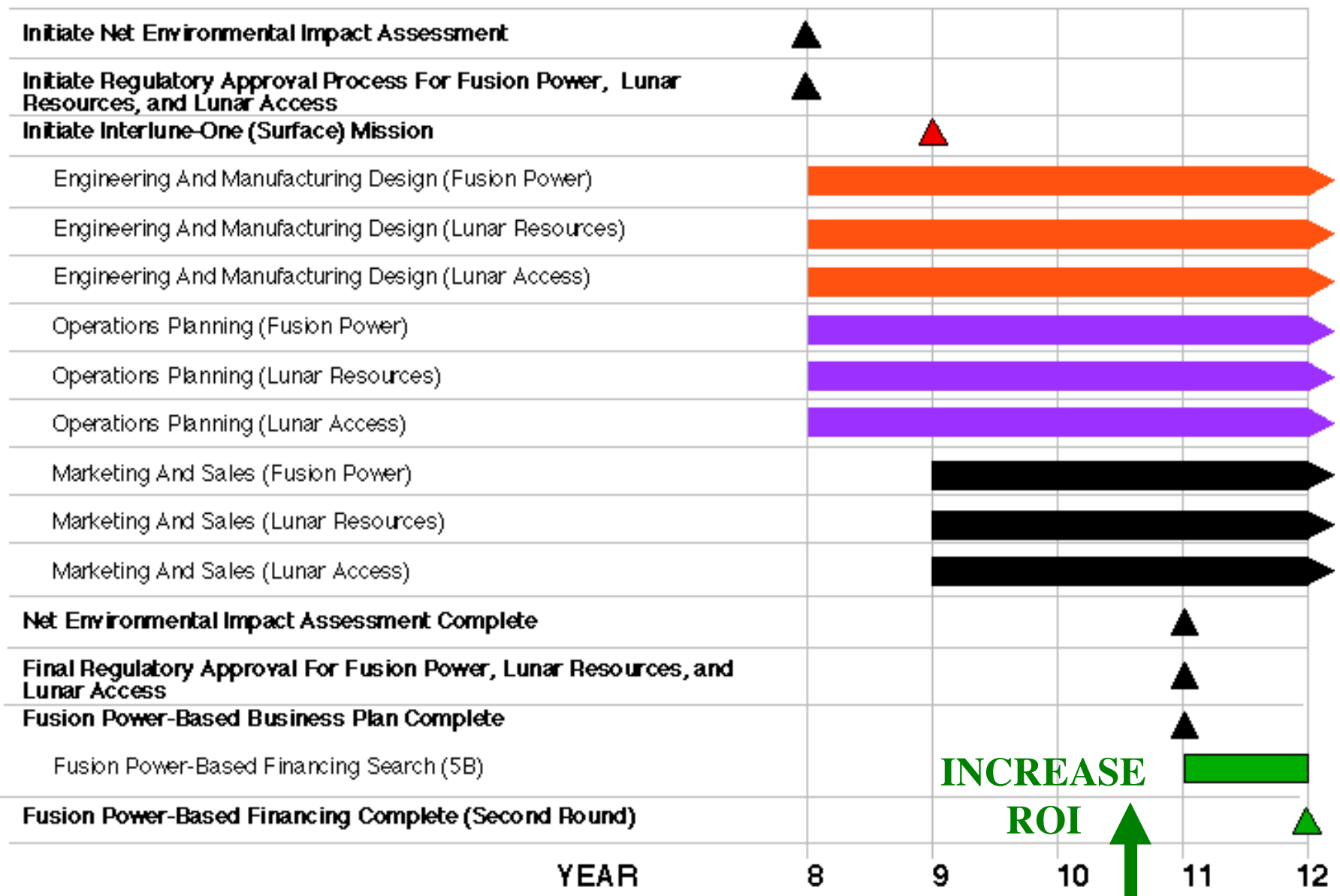
Phase I: Fusion Technology Startup (Venture Financing) – Years 0-5



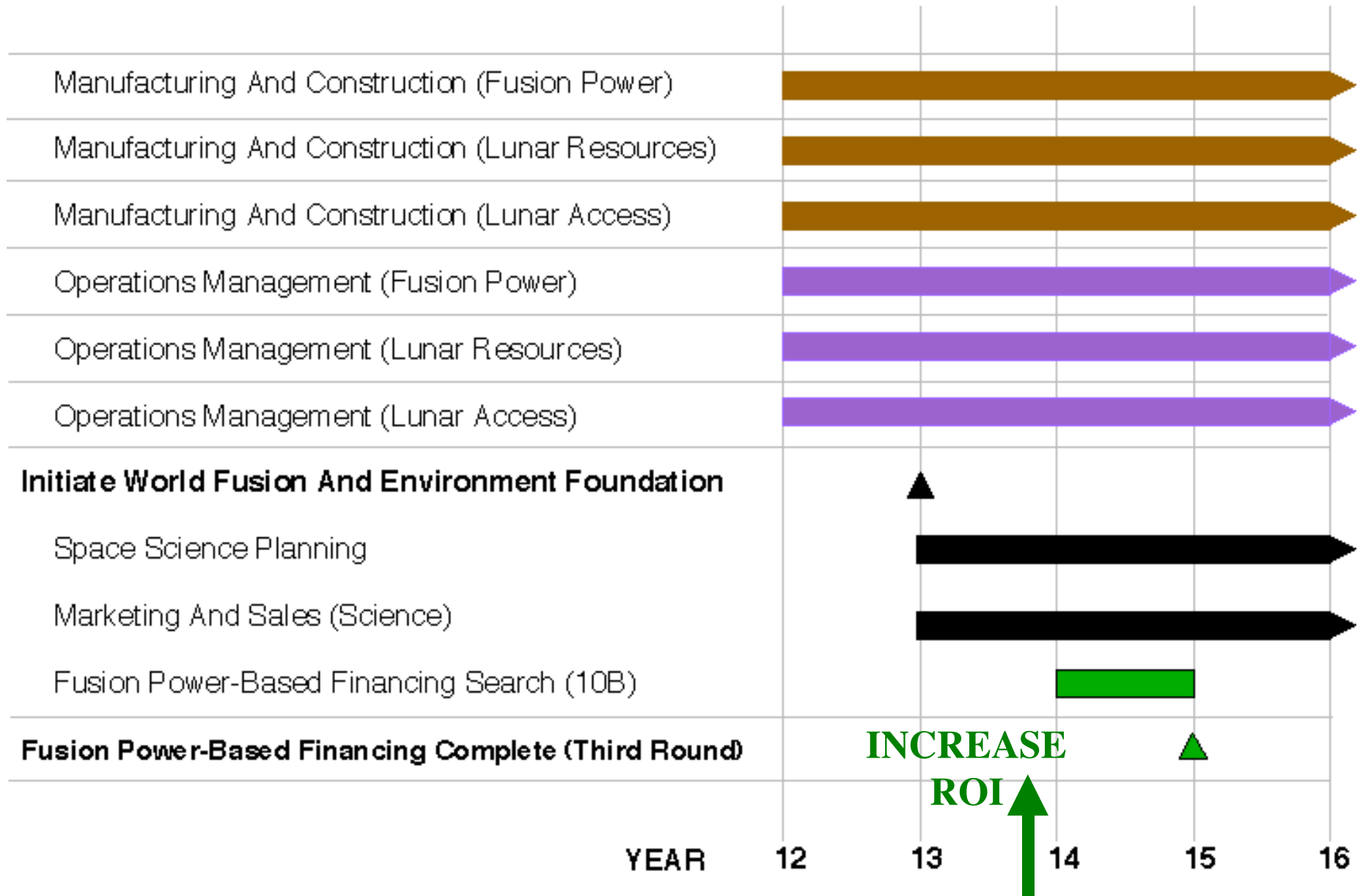
Phase II: Fusion Technology Business (Internal/Debt/Private Equity Financing) – Years 5-8



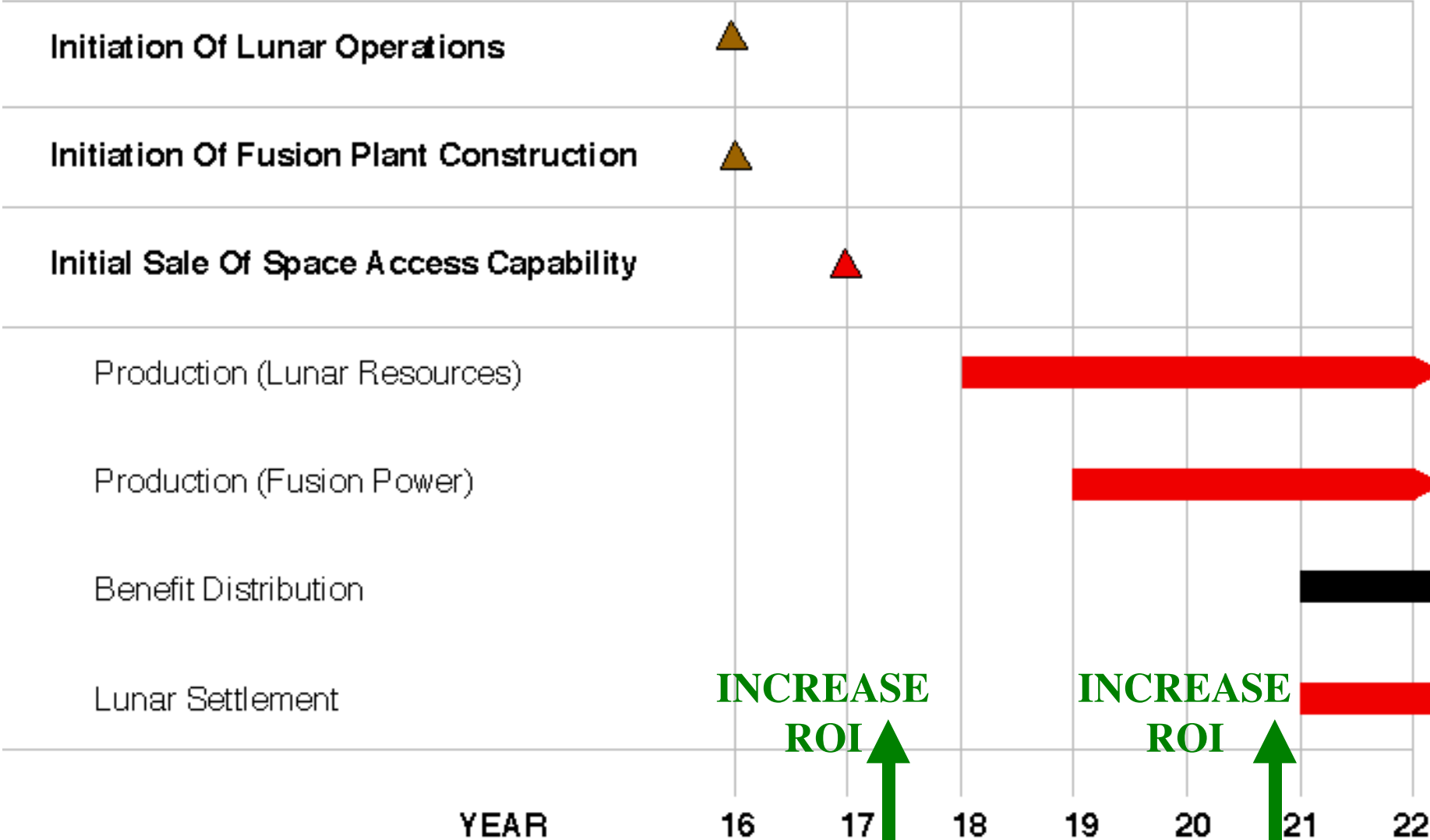
Phase III: Fusion Power/Lunar Resources Startup - Stage One (Internal/Private Equity Financing) - Years 8-12



Phase IV: Stage Two - Fusion Power/Lunar Resources Startup - Stage Two (Internal/Private Or Public Equity Financing) - Years 12-16

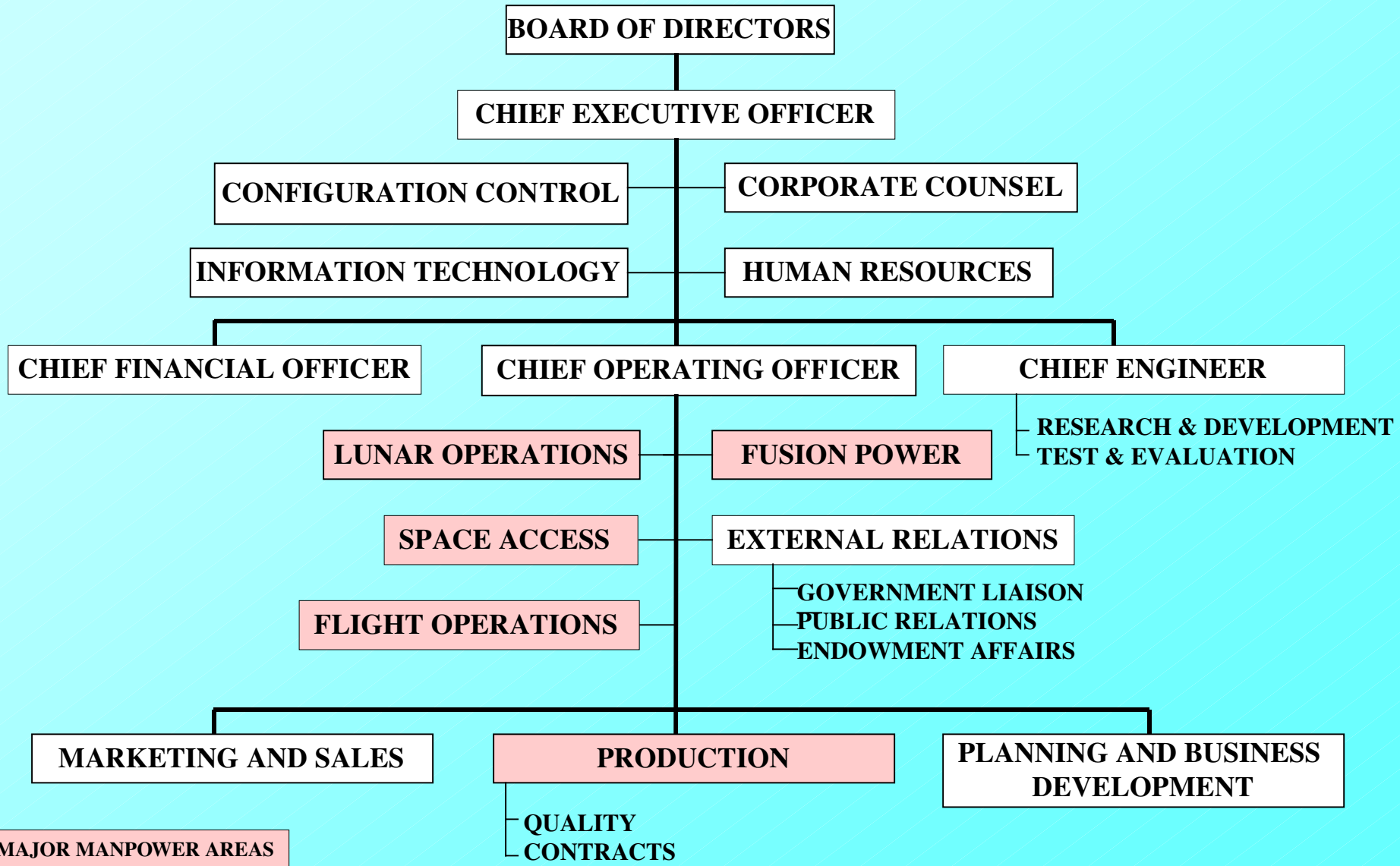


Phase V: Fusion Power, Lunar Resources, And Space Access Business (Internal/Public Equity Financing) - Years 16 - Subsequent



INTERLUNE INTERMARS INITIATIVE INC.

PRELIMINARY ORGANIZATION



“APOLLO BENT OUR SPECIES EVOLUTIONARY PATH INTO THE FUTURE.

“THE PHYSCOLOGICAL, TECHNOLOGICAL AND SURVIVAL BONDS HOLDING HUMANS TO EARTH HAVE BEEN BROKEN. THIS NEW EVOLUTIONARY STATUS IN THE UNIVERSE PERMITS US TO LIVE ON THE MOON AND MARS. YOUR GENERATION CAN DETERMINE HOW HUMANKIND TAKES ADVANTAGE OF THIS NEW STATUS. THUS, THE SETTLEMENT OF THE SOLAR SYSTEM AND THE REBIRTH OF FREEDOM AWAY FROM EARTH NOW IS IN YOUR CARE.”

Harrison H. Schmitt, NEEP533, Fall 2001

